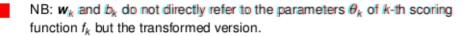
## LINEAR CLASSIFIERS

Linear classifiers are an important subclass of classification models. If the discriminant function(s)  $f_k(\mathbf{x})$  can be specified as linear function(s) (possibly through a rank-preserving, monotone transformation  $g: \mathbb{R} \to \mathbb{R}$ ), i. e.

$$g(f_k(\mathbf{x})) = \mathbf{w}_k^{\top} \mathbf{x} + b_k,$$

we will call the classifier a linear classifier.





## LINEAR CLASSIFIERS /2

We can also easily show that the decision boundary between classes i and j is a hyperplane. For every  $\mathbf{x}$  where there is a tie in scores:

$$f_i(\mathbf{x}) = f_j(\mathbf{x})$$

$$g(f_i(\mathbf{x})) = g(f_j(\mathbf{x}))$$

$$\mathbf{w}_i^{\top} \mathbf{x} + b_i = \mathbf{w}_j^{\top} \mathbf{x} + b_j$$

$$(\mathbf{w}_i - \mathbf{w}_j)^{\top} \mathbf{x} + (b_i - b_j) = 0$$

This is a **hyperplane** separating two classes.

